

PRELIMINARY DATA SUMMARY

March 1991

U.S. Army Engineer Waterways Experiment Station  
Coastal Engineering Research Center  
Field Research Facility  
Duck, North Carolina

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CERC Field Research Facility  
Duck, North Carolina

This report provides a summary of basic oceanographic, meteorological and bottom profile data for the month. The data were obtained as part of the Measurements and Analysis work units at the U.S. Army Engineer Waterways Experiment Station, Coastal Engineering Research Center's Field Research Facility (FRF) in Duck, North Carolina. The FRF staff collected and analyzed these data. These summaries are intended to make the data readily available to all FRF users, and comments on their content and usefulness are invited.

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## PART I: INTRODUCTION

The U.S. Army Engineer Waterways Experiment Station, Coastal Engineering Research Center's (CERC's) Field Research Facility (FRF) is located on the Outer Banks of North Carolina, near the village of Duck (Figure 1).

The FRF research program provides a means for obtaining high-quality field data, particularly during storms, in support of the U.S. Army Corps of Engineers' coastal engineering research missions. The research pier is a reinforced concrete structure supported on 0.9-m-diam steel piles spaced 12.2 m apart along the pier's length and 4.6 m apart across the width. The pier deck is 6.1 m wide and extends from behind the duneline to about the 6-m water depth contour at a height of 7.6 m above the National Geodetic Vertical Datum (NGVD). In addition, a main building contains offices, an instrument repair shop, and a data acquisition room.

One of the responsibilities of the FRF research program is the collection, analysis and dissemination of data on local oceanographic and meteorological conditions. Bottom profiles along both sides of the pier and periodic bathymetric surveys are also performed.

This summary is intended to provide basic data as soon as possible after they are obtained. Questions and/or comments concerning the data may be directed to Mr. Michael W. Leffler at (919) 261-3511.

Part II presents the meteorological data; Parts III through VI present oceanographic data; Part VII presents nearshore profiles and bathymetry; and Part VIII, if included, documents special events that occurred at the FRF during the month.

Table 1 is a list of instruments used, their operational status during the month, and the data collection status. Figure 2 identifies the location of the instruments. The water depths at the wave gages and current meters vary and may be determined from information contained in Figure 7. Other installation information is contained in Table 1.

Times given in the report, unless otherwise specified, are referenced to eastern standard time (EST).

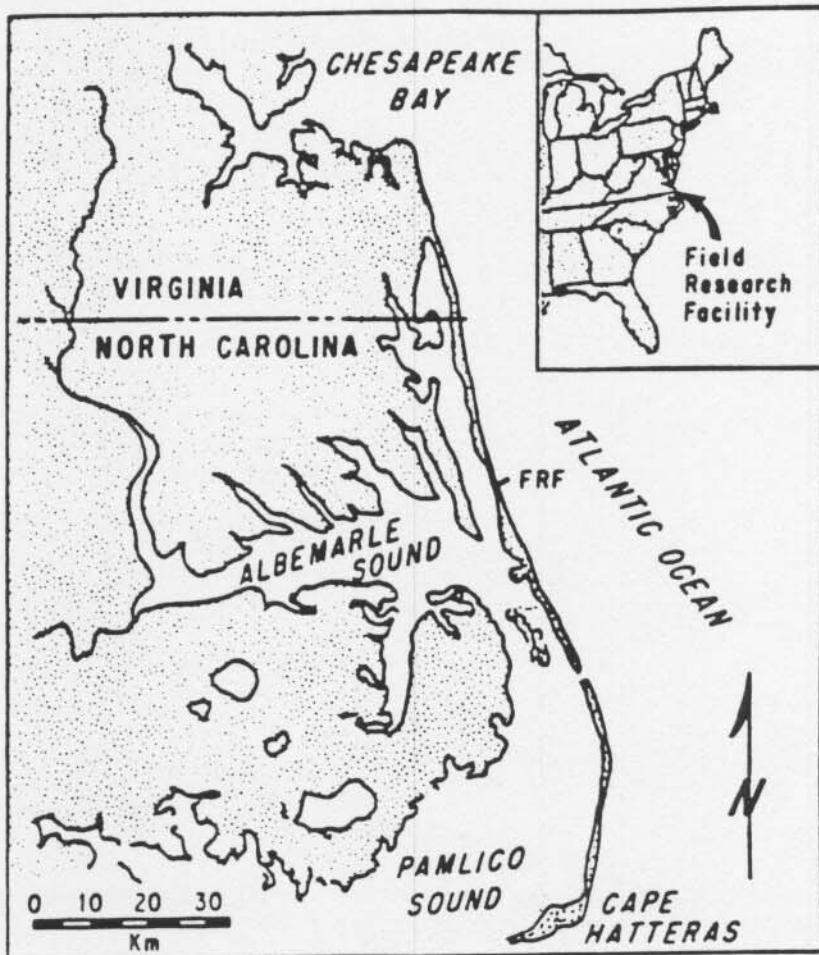


Figure 1. FRF location map

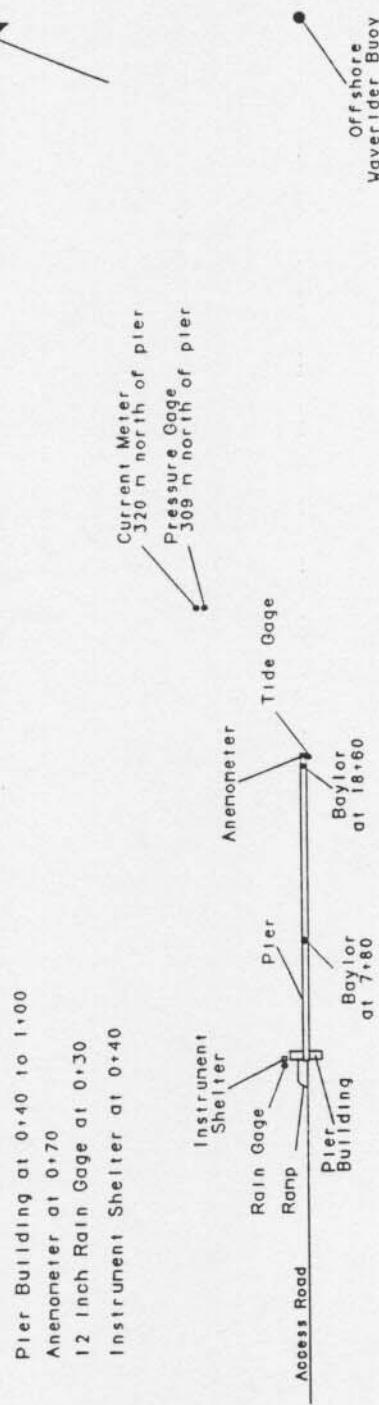
Table 1: Instrument Status/Data Availability

MAR 1991

Gage ID	Description/Remarks	Depth at Sensor		Day of the month																																
				1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1		
616	Barometric Pressure		Gage Status	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
			Data Collected	*	*	*	*	/	*	*	*	*	*	*	/	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*			
604	Precipitation		Gage Status	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*			
			Data Collected	*	*	*	*	/	*	*	*	*	*	*	/	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*			
624	Air Temperature		Gage Status	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*			
			Data Collected	*	*	*	/	*	*	*	*	*	*	*	/	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*			
932	Anemometer at seaward end of pier Elevation 19 m (NGVD)		Gage Status	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*			
			Data Collected	*	*	*	*	/	*	*	*	*	*	*	/	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
645	Baylor staff at station 7+80 on FRF pier	see Figure 7	Gage Status	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
			Data Collected	*	*	*	*	/	*	*	*	*	*	*	/	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
625	Baylor staff at station 18+60 on FRF pier	see Figure 7	Gage Status	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
			Data Collected	*	*	*	*	/	*	*	*	*	*	*	/	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
111	Pressure gage 309 m north of FRF pier (0.9 km offshore)	Approx. 7.8 m NGVD	Gage Status	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
			Data Collected	*	*	*	/	*	*	*	*	*	*	*	/	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
630	Waiverider buoy 6.0 km offshore	Approx. 23 m NGVD	Gage Status	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
			Data Collected	*	*	*	/	*	*	*	*	*	*	*	/	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
519	Current meter 320 m north of FRF pier (0.9 km offshore)	see Figure 7	Gage Status	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
			Data Collected	*	*	*	/	*	*	*	*	*	*	*	/	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
865-1370	NOAA tide station at seaward end of FRF pier		Gage Status	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
			Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Supplemental Observations (daily oceanographic and meteorological observations)				Daily observation	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	

Gage Status	Daily Observation	Analog Record	Data Collected
Operational = *	Complete = *	Complete = *	All = *
Partial = /	Partial = /	Partial = /	Partial = /
Non-Operational = -	None = -	None = -	None = -

True North



5

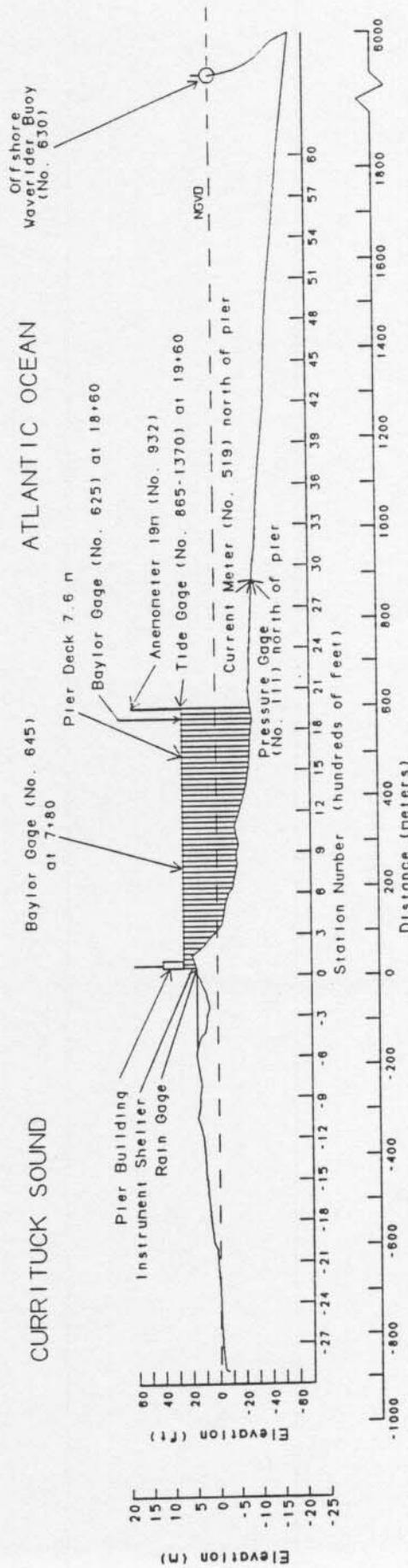


Figure 2. Instrument locations at FRF (all elevations from NGVD, all distances from FRF baseline).

## PART II: METEOROLOGICAL DATA

A variety of instruments have been installed at the FRF (Figure 2) to monitor the meteorological conditions. The data presented in Table 2 are collected and stored on magnetic tape using a Digital Equipment Corporation VAX 11/750. For each instrument identified in Table 1 as having analog outputs, chart records are obtained, a log is maintained and the records are stored for future reference.

Winds were measured at the end of the pier at an elevation of 19 m (Figure 2) using a Weather Measure Skyvane anemometer.

Monthly resultant wind speeds and directions are determined by vector averaging the data. Temperature and atmospheric pressure means are the average of the values presented for the month. Total precipitation is the sum for the month.

The following may be useful for converting the data in Table 2 to other frequently used units of measurement:

1. Millimeters (mm) to inches (in.) -  
 $mm \times .03937 = in.$
2. Millibars (mb) to inches of mercury (in. Hg) -  
 $mb \times 0.02953 = in. Hg$
3. Degrees Celsius (C) to degrees Fahrenheit (F) -  
 $(C \times 9/5) + 32 = F$
4. Meters per second (m/s) to knots (kn) -  
 $m/s \times 1.943 = kn$

Table 2: Meteorological Data

Mar 1991

Day	Hour	Wind Speed m/sec	Wind Direction deg TN	Temperature deg C	Atm Pressure mb	Precipitation mm
1	100	4	211	7.9	1022.6	0
	700	3	180	7.6	1022.6	0
	1300	5	126	14.2	1021.6	0
	1900	4	151	12.2	1017.9	0
2	100	11	173	18.4	1011.8	0
	700	9	230	15.3	1007.7	5
	1300	9	183	16.9	1004.3	5
	1900	6	193	14.5	1006.0	0
3	100	7	196	13.1	1004.3	0
	700	2	188	13.2	1003.0	0
	1300	10	139	14.3	998.2	2
	1900	3	150	13.7	994.9	20
4	100	12	194	15.8	987.7	4
	700	9	204	14.3	989.4	0
	1300	9	245	14.4	991.5	0
	1900	8	239	10.4	995.9	0
5	100	6	276	9.1	1000.6	0
	700	6	300	6.5	1006.0	0
	1300					0
	1900					0
6	100		<b>Hardware Error</b>			0
	700					0
	1300	7	186	14.3	1006.4	0
	1900	12	175	16.6	1001.0	0
7	100	11	211	16.3	997.2	0
	700	7	230	13.9	997.9	4
	1300	9	266	17.6	999.9	0
	1900	5	281	14.1	1004.7	0
8	100	8	37	9.6	1007.7	0
	700	9	4	6.6	1010.8	0
	1300	10	346	5.0	1011.1	0
	1900	7	345	5.0	1012.5	0
9	100	7	332	4.0	1013.8	0
	700	7	353	4.0	1015.9	0
	1300	8	10	5.1	1014.8	0
	1900	6	21	4.5	1013.1	0
10	100	8	10	6.1	1010.4	0
	700	7	342	4.8	1010.4	0
	1300	9	1	8.6	1010.8	0
	1900	9	331	7.0	1011.8	0
11	100	10	311	4.5	1012.8	0
	700	8	314	2.5	1014.5	0
	1300	12	331	7.6	1012.5	0
	1900	9	336	6.2	1012.8	0
12	100	10	341	3.5	1014.2	0
	700	7	329	2.2	1015.5	0
	1300	6	9	4.9	1014.5	0
	1900	3	111	4.9	1013.1	0
13	100	2	12	6.1	1013.1	0
	700	5	114	5.7	1010.1	0
	1300	7	135	9.6	1004.0	3
	1900	2	211	10.9	1001.0	0
14	100	5	314	7.3	999.6	0
	700	6	320	6.3	999.6	6
	1300	6	270	6.6	1001.0	0
	1900	7	308	5.2	1005.4	0
15	100		<b>Hardware Error</b>			0
	700					0
	1300	11	343	5.9	1014.8	0
	1900	11	356	5.9	1018.6	0
16	100	10	1	6.2	1021.3	0
	700	11	352	5.2	1024.0	0
	1300	6	5	7.9	1024.7	0
	1900	0		4.9	1024.3	0

\* electronic problems

(Continued)

Table 2: Meteorological Data

Mar 1991

Day	Hour	Wind Speed m/sec	Wind Direction deg TN	Temperature deg C	Atm Pressure mb	Precipitation mm
17	100	2	218	3.8	1025.3	0
	700	1	230	5.5	1025.0	0
	1300	4	71	10.6	1024.0	0
	1900	4	122	7.3	1020.6	0
18	100	7	145	8.5	1015.2	0
	700	10	180	15.4	1008.7	0
	1300	4	250	13.1	1001.3	14
	1900	4	213	12.3	1000.3	0
19	100	6	270	10.8	1000.6	0
	700	8	284	8.6	1003.0	0
	1300	9	316	12.4	1004.3	0
	1900	6	293	10.8	1006.4	0
20	100	6	288	8.2	1010.4	0
	700	6	275	8.7	1014.2	0
	1300	6	241	15.7	1013.8	0
	1900	4	244	12.9	1014.2	0
21	100	5	226	10.8	1015.2	0
	700	5	231	11.0	1016.5	0
	1300	5	165	13.7	1016.5	0
	1900	10	199	16.3	1014.8	0
22	100	6	221	13.9	1015.5	0
	700	6	215	13.9	1015.9	0
	1300	8	296	18.3	1016.5	0
	1900	7	199	18.2	1013.1	0
23	100	1	6	11.4	1015.2	0
	700	4	14	9.3	1015.5	0
	1300	5	129	14.6	1011.1	0
	1900	10	207	18.4	1004.0	0
24	100	7	238	17.3	1003.7	0
	700	7	253	16.1	1004.3	0
	1300	11	248	22.6	1000.3	0
	1900	6	293	19.8	1001.3	0
25	100	8	356	9.3	1008.4	0
	700	5	329	10.7	1011.1	0
	1300	4	48	12.2	1012.8	0
	1900	6	134	9.6	1014.2	0
26	100	4	51	9.0	1015.9	0
	700	5	34	9.8	1018.2	0
	1300	3	44	11.6	1018.6	0
	1900	4	106	10.2	1016.5	0
27	100	7	138	11.3	1013.5	0
	700	6	196	15.5	1012.1	0
	1300	10	205	23.2	1010.1	0
	1900	12	211	19.7	1007.0	0
28	100	12	222	18.9	1003.7	0
	700	9	212	18.8	1003.3	0
	1300	8	244	21.5	1003.0	0
	1900	6	221	20.0	1002.3	0
29	100	5	219	17.7	1002.6	0
	700	8	202	17.7	1000.6	0
	1300	14	197	22.6	997.2	0
	1900	14	199	21.0	993.8	0
30	100	5	189	17.5	992.8	114
	700	9	256	17.7	995.5	9
	1300	13	353	6.6	1006.7	0
	1900	10	2	6.8	1013.1	0
31	100	6	32	6.9	1017.2	0
	700	10	27	7.3	1018.2	0
	1300	10	17	7.4	1017.9	0
	1900	9	8	7.3	1014.8	0
Resultant				Mean	Mean	Total
2				11.2	1009.5	186

\* electronic problems

(Sheet 2 of 2)

### PART III: WAVE DATA

Wave data are collected from two Baylor staff gages (Gages 625 and 645), a pressure wave gage (Gage 111) and a Waverider buoy (Gage 630) as shown in Table 1 and Figure 2. The data are collected, analyzed, and stored on magnetic tape using a Digital Equipment Corporation VAX 11/750 programmed to sample the wave gages every 6 hr (more frequently during storms) beginning at 0100, 0700, 1300, and 1900 EST. The sampling rate is two times per second for four contiguous 34-min records.

Wave height  $H_{mo}$  is an energy-based statistic equal to four times the standard deviation of the sea surface elevations. Wave height reported from the pressure gage has been compensated for hydrodynamic attenuation using linear wave theory. Wave period is identified from the computation of a variance (energy) spectrum with 60 deg of freedom calculated from a 34-min record. Peak wave period  $T_p$  is defined as the period associated with the maximum energy in the spectrum. When this analysis is complete, the data are written to magnetic tape.

Table 3 presents the wave heights and periods for each wave record obtained at 6 hr intervals during the month. The monthly means and standard deviations from the means shown in Table 3 are average values computed from this data. Figure 3 is a time history of all  $H_{mo}$  and  $T_p$  values obtained for all gages.

Differences in wave periods between wave gages (Table 3 and Figure 3) may be the result of wave breaking, wave reformation, or the presence of multiple wave trains containing nearly equal energy.

Table 3: Wave Data

Mar 1991

Day	Hour	645		625		111		630	
		Baylor at 7+80	Hmo.m T.sec	Baylor at 18+60	Hmo.m T.sec	Pressure Gage	Hmo.m T.sec	Offshrd Wvrdr	Hmo.m T.sec
1	0100	0.22	10.67	0.49	10.24	0.47	10.24	0.50	10.24
	0700	0.49	5.33	0.62	10.24	0.65	9.48	0.87	5.57
	1300	0.33	9.85	0.59	9.85	0.63	10.24	0.71	10.24
	1900	0.45	9.85	0.57	10.24	0.67	9.48	0.79	9.48
2	0100	0.78	6.74	0.93	7.11	1.05	6.92	1.27	6.74
	0700	1.03	8.26	1.16	8.53	1.42	7.76	1.83	8.26
	1300	0.87	9.85	1.21	9.85	1.30	9.48	1.55	9.48
	1900	0.82	9.14	1.01	8.83	1.08	8.83	1.37	8.83
3	0100	0.70	8.83	0.98	9.14	1.02	9.48	1.22	9.48
	0700	0.71	9.48	0.92	8.53	1.00	8.83	1.18	9.14
	1300	0.54	9.14	0.87	8.83	0.93	8.53	1.07	9.14
	1900	1.03	8.26	1.11	8.83	1.26	9.14	1.51	8.53
4	0100	0.98	10.24	1.25	9.48	1.33	9.48	1.56	8.83
	0700	1.08	4.83	1.10	10.24	1.24	9.48	1.70	10.24
	1300	0.83	11.64	1.01	10.67	1.13	10.67	1.42	11.13
	1900	0.99	11.13	1.08	11.13	1.18	11.13	1.46	10.67
5	0100	0.84	11.64	1.02	11.64	1.22	11.13	1.37	11.13
	0700	0.89	11.13	1.09	11.13	1.12	10.67	1.29	10.67
	1300								
	1900								
6	0100								
	0700								
	1300	0.56	10.67	0.79	10.24	0.80	10.24	0.85	9.85
	1900	0.56	10.24	0.85	9.85	0.79	9.85	0.98	9.85
7	0100	0.70	10.24	0.88	10.24	0.86	10.24	1.10	10.24
	0700	0.50	10.24	0.74	10.24	0.73	10.24	0.94	10.67
	1300	0.38	9.85	0.57	10.24	0.53	9.85	0.85	10.24
	1900	0.28	10.24	0.50	10.24	0.54	9.85	0.69	10.24
8	0100	0.66	3.56	0.79	10.24	0.74	3.46	0.91	9.85
	0700	0.81	5.02	1.02	5.45	1.01	5.45	1.21	5.02
	1300	0.92	5.02	0.94	5.02	1.01	5.02	1.15	5.45
	1900	0.59	5.57	0.68	5.02	0.77	6.09	1.16	5.12
9	0100	0.63	5.12	0.67	5.69	0.73	5.57	1.10	5.12
	0700	0.88	5.82	1.07	6.92	1.13	6.92	1.57	5.02
	1300	0.93	5.82	0.91	5.33	1.00	5.45	1.37	5.45
	1900	0.76	7.11	0.90	7.31	0.93	6.56	1.20	7.76
10	0100	0.70	6.92	0.73	6.09	0.79	7.11	1.05	6.92
	0700	0.97	5.33	1.17	5.33	1.20	5.45	1.38	5.95
	1300	1.08	6.40	1.09	6.56	1.26	5.95	1.23	5.95
	1900	1.09	5.95	1.12	5.69	1.17	6.92	1.45	5.45
11	0100	1.15	6.40	0.96	6.56	1.17	6.56	1.91	5.82
	0700	1.25	5.95	1.10	6.24	1.27	6.56	1.61	6.56
	1300	1.33	7.11	1.49	7.11	1.56	6.92	1.96	6.09
	1900	1.26	6.56	1.27	6.24	1.30	6.92	1.70	6.92
12	0100	1.33	6.40	1.41	6.56	1.52	6.74	1.85	6.24
	0700	1.22	6.92	1.19	7.53	1.26	6.92	1.48	6.09
	1300	1.15	5.82	1.09	6.74	1.15	7.76	1.27	6.24
	1900	0.96	6.40	0.95	10.67	1.01	8.26	0.97	7.76
13	0100	0.78	6.09	0.84	10.24	0.87	7.53	0.94	10.24
	0700	0.71	13.47	0.93	14.22	0.98	13.47	0.90	10.24
	1300	0.86	13.47	1.12	13.47	1.12	12.80	1.14	13.47
	1900	0.80	12.19	1.08	12.80	1.12	12.80	1.19	11.64
14	0100	0.80	12.80	1.00	12.19	1.00	12.80	1.05	12.19
	0700	1.13	6.56	1.26	6.92	1.31	7.53	1.41	8.83
	1300	0.90	8.00	0.95	7.53	0.97	8.00	1.18	8.83
	1900	0.85	5.22	0.84	9.48	0.92	8.00	1.14	8.53
15	0100								
	0700								
	1300	1.09	9.85	1.56	10.24	1.81	9.85	1.88	9.85
	1900	1.34	11.13	1.78	10.24	1.88	10.24	2.02	10.24
16	0100	1.02	11.13	1.76	10.67	1.99	11.64	1.90	10.67
	0700	1.29	12.19	1.92	12.19	1.85	11.64	1.89	11.64
	1300	0.92	11.64	1.60	11.13	1.65	12.19	1.64	11.64
	1900	1.23	12.19	1.50	12.80	1.66	12.19	1.44	12.19

\* Electronic problems

(Continued)

(Sheet 1 of 2)

Table 3: Wave Data

Mar 1991

Day	Hour	645		625		111		630	
		Baylor at 7+80	Hmo.m T.sec	Baylor at 18+60	Hmo.m T.sec	Pressure Gage	Hmo.m T.sec	Offshsr Wvrdr	Hmo.m T.sec
17	0100	0.94	13.47	1.49	11.13	1.60	12.19	1.39	11.64
	0700	1.05	12.19	1.34	11.64	1.41	12.19	1.24	11.64
	1300	1.01	13.47	1.40	12.80	1.33	12.19	1.16	12.80
	1900	1.07	12.80	1.39	12.80	1.30	12.80	1.41	12.19
18	0100	0.83	12.80	1.34	12.19	1.39	12.19	1.24	12.80
	0700	0.95	12.19	1.36	12.19	1.42	12.19	1.22	12.80
	1300	0.90	13.47	1.53	12.80	1.49	12.80	1.79	7.11
	1900	1.04	12.80	1.34	11.13	1.59	12.19	1.75	8.26
19	0100	0.88	11.64	1.22	11.64	1.39	10.24	1.52	9.48
	0700	0.69	12.19	1.05	11.13	1.17	9.85	1.14	9.14
	1300	0.79	12.80	1.05	12.19	1.09	12.80	1.20	10.67
	1900	0.77	5.45	0.86	10.24	0.94	10.24	1.07	10.24
20	0100	0.51	12.80	0.59	12.19	0.61	11.64	0.77	10.24
	0700	0.39	12.80	0.52	11.64	0.55	12.19	0.71	9.85
	1300	0.29	11.64	0.44	12.19	0.49	9.85	0.53	9.85
	1900	0.35	12.19	0.47	11.64	0.53	12.80	0.50	9.48
21	0100	0.38	14.22	0.50	14.22	0.48	11.13	0.55	11.13
	0700	0.27	16.00	0.59	12.80	0.55	13.47	0.55	12.80
	1300	0.38	14.22	0.53	12.80	0.60	12.19	0.55	12.19
	1900	0.34	16.00	0.59	12.19	0.60	12.19	0.65	11.64
22	0100	0.34	13.47	0.47	13.47	0.50	13.47	0.59	12.19
	0700	0.26	16.00	0.48	12.19	0.46	12.80	0.53	13.47
	1300	0.35	12.80	0.50	12.80	0.51	11.64	0.66	12.80
	1900	0.23	14.22	0.47	12.80	0.45	12.19	0.61	12.19
23	0100	0.34	12.19	0.52	12.19	0.53	12.19	0.68	6.24
	0700	0.48	4.06	0.64	11.64	0.66	12.80	0.79	6.56
	1300	0.86	7.31	0.85	7.76	0.87	7.11	1.09	7.31
	1900	0.79	7.53	0.91	8.53	1.00	8.00	1.30	8.83
24	0100	0.73	9.14	0.93	9.14	0.87	9.14	1.16	8.83
	0700	0.69	9.48	0.81	9.48	0.90	9.14	1.01	9.48
	1300	0.58	9.14	0.82	9.85	0.90	9.48	1.00	9.48
	1900	0.48	8.53	0.68	9.48	0.69	8.83	0.87	8.53
25	0100	0.92	4.27	0.90	4.41	1.10	4.13	1.03	4.13
	0700	0.87	6.09	0.87	5.82	0.95	6.24	1.16	6.09
	1300	0.68	4.66	0.76	9.85	0.75	8.26	0.82	8.00
	1900	0.40	10.24	0.57	10.24	0.55	9.85	0.58	9.14
26	0100	0.38	10.24	0.49	9.14	0.52	10.67	0.57	10.67
	0700	0.37	11.13	0.44	11.13	0.48	10.24	0.53	10.24
	1300	0.57	11.13	0.61	11.13	0.61	10.67	0.69	10.24
	1900	0.50	10.67	0.60	10.67	0.57	10.67	0.63	10.24
27	0100	0.62	10.24	0.81	10.24	0.68	9.48	0.81	10.24
	0700	0.52	11.13	0.77	10.67	0.82	10.67	0.87	10.24
	1300	0.46	9.85	0.83	9.85	0.88	10.67	1.00	10.67
	1900	0.60	11.13	0.76	11.13	0.78	11.13	1.13	11.13
28	0100	0.49	12.19	0.71	11.64	0.81	11.64	0.90	11.13
	0700	0.52	12.19	0.68	11.64	0.67	11.64	0.83	11.64
	1300	0.48	11.64	0.54	11.64	0.54	11.13	0.71	11.13
	1900	0.41	11.13	0.53	11.13	0.55	11.64	0.56	11.13
29	0100	0.41	8.53	0.49	11.64	0.53	11.13	0.56	8.53
	0700	0.40	10.67	0.49	10.67	0.56	11.13	0.58	10.67
	1300	0.64	4.06	0.66	11.13	0.71	11.13	0.98	3.88
	1900	0.72	4.34	0.78	8.26	0.83	3.82	1.27	4.27
30	0100	0.63	7.31	0.67	7.76	0.71	11.13	1.02	8.53
	0700	0.67	5.95	0.84	10.67	0.90	11.13	1.33	11.13
	1300	1.16	5.95	1.67	5.95	1.86	5.57	2.09	5.57
	1900	1.30	7.53	1.50	7.53	1.75	7.53	1.91	7.53
31	0100	0.82	8.83	1.13	7.11	1.20	8.53	1.35	8.26
	0700	1.08	7.76	1.22	8.53	1.31	8.26	1.34	8.26
	1300	0.87	4.57	1.24	8.00	1.31	5.12	1.37	8.83
	1900	1.17	5.82	1.28	5.45	1.41	5.95	1.74	5.57
Mean		0.75	9.41	0.94	9.80	0.99	9.59	1.14	9.18
Std dev		0.29	3.08	0.34	2.34	0.37	2.43	0.40	2.32

\* Electronic problems

(Sheet 2 of 2)

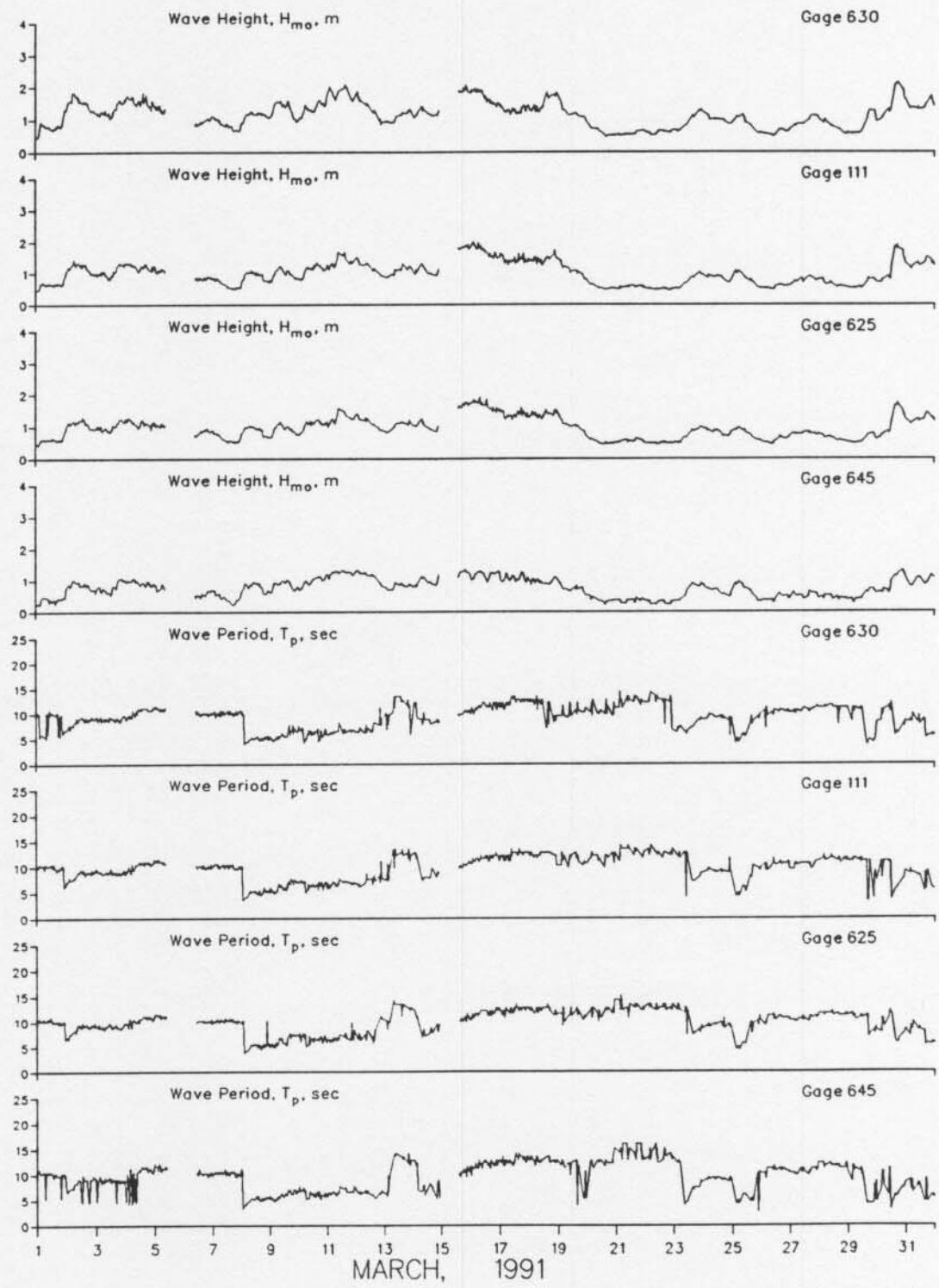


Figure 3. Time history of wave heights and periods

#### PART IV: CURRENT DATA

Current data (Table 4) are collected from a Marsh-McBirney electromagnetic biaxial current meter (Table 1 and Figure 2) and by visually observing the movement of dye on the water surface in the surf and at the seaward end of the pier, as well as 500 m updrift of the pier 12 m offshore.

Since the shoreline orientation is approximately N20W, longshore currents flow either toward 340 deg (i.e. northward) or toward 160 deg (i.e. southward). Similarly, cross-shore currents are either onshore (westward) or offshore (eastward).

All current speeds are given in centimeters per second (cm/sec). Resultant speeds and directions are determined by vector averaging the data.

Table 4: Current Data  
Mar 1991

Day	Alongshore Cross-shore Resultant Time	Pier Measurements				Beach Measurements (500m Updrift)				Current Meter		
		Dye at (579 m) (surface)	Speed	Dir	Dye at Mid-Surf Zone (surface)	Distance from Baseline (m)	Speed	Dir	Dye 12m offshore (surface)	Location	Speed	Dir
1 0100-Along Cross Result											5	N
1 0700-Along Cross Result	34 0 340	N off	140		30 5 31	N off 349			15	N	4 0 4	on 301 340
1 1300-Along Cross Result											1 1 1	N on 295
1 1900-Along Cross Result											5 4 6	N off 19
2 0100-Along Cross Result											1 4 4	S on 236
2 0700-Along Cross Result	30 12 33	N off 2	177		30 2 31	N off 343			36	N	18 6 19	N on 322
2 1300-Along Cross Result											8 9 12	N on 292
2 1900-Along Cross Result											6 6 8	N on 295
3 0100-Along Cross Result											1 5 5	N on 261
3 0700-Along Cross Result	30 6 31	N off 351	177		20 6 21	N off 357			41	N	14 4 15	N on 324
3 1300-Along Cross Result											14 3 14	N on 328
3 1900-Along Cross Result											11 6 13	N on 311
4 0100-Along Cross Result											15 5 16	N on 322
4 0700-Along Cross Result	51 10 52	N off 351	189		30 3 31	N off 346			20	N	25 10 27	N on 318
4 1300-Along Cross Result											13 9 16	N on 305
4 1900-Along Cross Result											11 7 13	N on 308
5 0100-Along Cross Result											7 2 7	S off 144
5 0700-Along Cross Result	24 0 24	S off 160	165		17 16 23	N off 22			17	N	10 4 11	S off 138
5 1300-Along Cross Result												
5 1900-Along Cross Result												

KEY = All speeds in cm/sec  
N = Northward, Shore parallel  
S = Southward, Shore parallel  
on = onshore off = offshore

Table 4: Current Data (Continued)  
Mar 1991

Alongshore Cross-shore Resultant Time Day	Pier Measurements				Beach Measurements (500m Updrift)				Current Meter	
	Dye at (579 m) (surface)	Dir	Dye at Mid-Surf Zone (surface)	Distance from Baseline (m)	Speed	Dir	Dye 12m offshore (surface)	Location	Speed	Dir
6 0100-Along Cross Result										
6 0700-Along Cross Result	41 12 42	N off 357		165	61 9 62	N off 349		41 N South		
6 1300-Along Cross Result									10 4 11	N on 318
6 1900-Along Cross Result									25 6 26	N on 327
7 0100-Along Cross Result									22 8 23	N on 320
7 0700-Along Cross Result	11 10 15	N off 22		177	14 8 16	N off 11		25 N South	12 7 14	N on 310
7 1300-Along Cross Result									1 6 6	S on 241
7 1900-Along Cross Result									10 1 10	S off 154
8 0100-Along Cross Result									12 5 13	S off 137
8 0700-Along Cross Result	41 12 42	S on 177		189	102 5 102	S off 157		46 S North	18 6 19	S off 142
8 1300-Along Cross Result									17 6 18	S off 141
8 1900-Along Cross Result									41 13 43	S off 142
9 0100-Along Cross Result									13 5 14	S off 139
9 0700-Along Cross Result	87 0	S off		177	61 0	S off		33 S North	40 14 42	S off 141
9 1300-Along Cross Result	87 160				61 160				46 12 48	S off 145
9 1900-Along Cross Result									50 23 55	S off 135
10 0100-Along Cross Result									36 9 37	S off 146
10 0700-Along Cross Result	61 6 61	S on 166		189	102 0 102	S off 160		43 S North	28 14 31	S off 133
10 1300-Along Cross Result									46 17 49	S off 140
10 1900-Along Cross Result									44 17 47	S off 139

KEY = All speeds in cm/sec  
 N = Northward, Shore parallel  
 S = Southward, Shore parallel  
 on = onshore off = offshore

Table 4: Current Data (Continued)  
Mar 1991

Alongshore Cross-shore Resultant Time Day	Pier Measurements				Beach Measurements (500m Updrift)				Current Meter		
	Dye at (579 m) (surface)	Speed	Dir	Dye at Mid-Surf Zone (surface)	Distance from Baseline (m)	Speed	Dir	Dye 12m offshore (surface)	Location	Speed	Dir
11 0100-Along Cross Result										32	S
11 0700-Along Cross Result	122 0	S		189	203 0	S off		46	S	10	off
11 1300-Along Cross Result	122	160			203	160				34	143
11 1900-Along Cross Result										19	S
12 0100-Along Cross Result										5	off
12 0700-Along Cross Result	24 1	S off		201	61 3	S off		30	S	20	145
12 1300-Along Cross Result	24	157			61	157				40	S
12 1900-Along Cross Result										6	off
13 0100-Along Cross Result										40	151
13 0700-Along Cross Result	8 0	S		189	41 4	N off		38	N	50	S
13 1300-Along Cross Result	8	160			41	346				18	off
13 1900-Along Cross Result										53	140
14 0100-Along Cross Result										32	S
14 0700-Along Cross Result	36 9	S off		189	41 2	S off		13	S	6	off
14 1300-Along Cross Result	37	146			41	157				33	149
14 1900-Along Cross Result										31	S
15 0100-Along Cross Result										9	off
15 0700-Along Cross Result	102 0	S off		165	61 3	S off		41	S	8	139
15 1300-Along Cross Result	102	160			61	157				8	off
15 1900-Along Cross Result										11	115
										3	N
										0	
										3	340
										2	277
										4	N
										2	on
										4	313
										22	S
										15	off
										27	126
										17	S
										5	off
										18	144
										32	S
										17	off
										36	132

KEY = All speeds in cm/sec  
 N = Northward, Shore parallel  
 S = Southward, Shore parallel  
 on = onshore off = offshore

Table 4: Current Data (Continued)  
Mar 1991

Day	Time	Pier Measurements				Beach Measurements (500m Updrift)			Current Meter	
		Alongshore Cross-shore Resultant	Dye at (579 m) (surface)	Dye at Mid-Surf Zone (surface)	Distance from Baseline (m)	Speed	Dir	Dye 12m offshore (surface)	Location	Speed
16	0100-Along Cross Result									0.9 km Offshore Depth -5.6m (NGVD) ID #519
		Time	Speed	Dir	Distance from Baseline (m)	Speed	Dir	Location	Speed	Dir
16	0700-Along Cross Result	203 0	S off	177	122 0	S off		33 S	37	S
		203 160			122 160			North	13 39	off 141
16	1300-Along Cross Result								29	S
									11	off
16	1900-Along Cross Result								31	139
									8	S
									1	on
16									8	167
17	0100-Along Cross Result								24	S
									17	off
17	0700-Along Cross Result	15 0	S	0				5 N	10	S
		15 160		177	0			South	1	on
17	1300-Along Cross Result								10	166
									11	S
17	1900-Along Cross Result								16	off
									19	105
18	0100-Along Cross Result								9	S
									0	
18	0700-Along Cross Result	41 4	N off	165	61 3	N off		30 N	5	S
		41 346			61 343			South	3	on
18	1300-Along Cross Result								6	191
									0	
18	1900-Along Cross Result								5	on
									5	250
19	0100-Along Cross Result								4	N
									2	on
19	0700-Along Cross Result	17 1	S off	177	11 9	N off		3 N	4	313
		17 157			14 19			South	5	S
19	1300-Along Cross Result								1	on
									5	171
19	1900-Along Cross Result								0	
									12	off
20	0100-Along Cross Result								12	70
									29	S
20	0700-Along Cross Result	61 18	S off	165	30 9	S off		23 S	12	off
		64 143			32 143			North	24	136
20	1300-Along Cross Result								25	S
									9	off
20	1900-Along Cross Result								27	140
									11	S
									5	off
									12	136

KEY = All speeds in cm/sec

N = Northward, Shore parallel

S = Southward, Shore parallel

on = onshore off = offshore

Table 4: Current Data (Continued)  
Mar 1991

Day	Time	Pier Measurements				Beach Measurements (500m Updrift)			Current Meter	
		Dye at (579 m) (surface)	Distance from Baseline (m)	Speed	Dir	Dye 12m offshore (surface)	Location	Speed	Dir	0.9 km Offshore Depth -5.6m (NGVD) ID #519
21	0100-Along Cross Result									16 S
		Speed	Dir							16 off
										23 115
21	0700-Along Cross Result	12 4 off	165	0			2 S	9	S	
		12 143		0	0	North		0		
								9	160	
21	1300-Along Cross Result									13 S
										3 off
										13 147
21	1900-Along Cross Result									5 N
										5 on
										7 295
22	0100-Along Cross Result									3 N
										4 on
										5 287
22	0700-Along Cross Result	17 5 off	165	15 0	N		13 N	7	N	
		18 357		15 340		South		1	on	
								7	332	
22	1300-Along Cross Result									2 N
										3 off
										4 36
22	1900-Along Cross Result									1 S
										3 on
										3 232
23	0100-Along Cross Result									8 S
										5 off
										9 128
23	0700-Along Cross Result	29 4 on	165	17 4	S off		15 N	15	S	
		29 169		18 146		North		3	off	
								15	149	
23	1300-Along Cross Result									19 S
										4 off
										19 148
23	1900-Along Cross Result									21 S
										3 off
										21 152
24	0100-Along Cross Result									29 S
										12 off
										31 138
24	0700-Along Cross Result	0 12 off	177	23 18	N off		49 S	14	S	
		12 70		29 17		North		3	off	
								14	148	
24	1300-Along Cross Result									14 S
										3 on
										14 172
24	1900-Along Cross Result									8 S
										0
										8 160
25	0100-Along Cross Result									24 S
										27 off
										36 112
25	0700-Along Cross Result	32 6 off	165	76 8	S on		42 S	8	S	
		33 149		77 166		North		1	off	
								8	153	
25	1300-Along Cross Result									10 S
										9 off
										13 118
25	1900-Along Cross Result									17 S
										8 off
										19 135

KEY = All speeds in cm/sec  
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S = Southward, Shore parallel  
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Table 4: Current Data (Continued)  
Mar 1991

Day	Alongshore Cross-shore Resultant Time	Pier Measurements				Beach Measurements (500m Updrift)			Current Meter	
		Dye at (579 m) (surface)	Distance from Baseline (m)	Speed	Dir	Dye 12m offshore (surface)	Location	Speed	Dir	0.9 km Offshore Depth -5.6m (NGVD) ID #519
26	0100-Along Cross Result							11	S	
								7	off	
								13	128	
26	0700-Along Cross Result	17 3 17	S on 171	165	18 3 18	S on 169	North	17	S	32
								10	off	
								34	143	
26	1300-Along Cross Result							22	S	
								9	off	
								24	138	
26	1900-Along Cross Result							21	S	
								12	off	
								24	130	
27	0100-Along Cross Result							1	S	
								8	off	
								8	77	
27	0700-Along Cross Result	27 16 31	N off 11	177	30 15 34	N off 7	South	10	N	6
								3	off	
								7	133	
27	1300-Along Cross Result							3	N	
								2	on	
								4	306	
27	1900-Along Cross Result							5	S	
								7	on	
								9	214	
28	0100-Along Cross Result							12	N	
								13	on	
								18	293	
28	0700-Along Cross Result	25 26	N off 351	165	27 11 29	N off 2	South	9	N	
								1	S	
								12	on	
								12	245	
28	1300-Along Cross Result							0		
								2	on	
								2	250	
28	1900-Along Cross Result							3	N	
								6	on	
								7	277	
29	0100-Along Cross Result							2	N	
								4	on	
								4	277	
29	0700-Along Cross Result	18 20	N off 7	155	27 13 30	N off 7	South	23	N	8
								18	N	
								20	on	
								20	274	
29	1300-Along Cross Result							8	N	
								20	on	
								22	272	
29	1900-Along Cross Result							1	N	
								3	on	
								3	268	
30	0100-Along Cross Result							9	S	
								1	off	
								9	154	
30	0700-Along Cross Result	38 39	S on 171	152	28 4 28	S on 169	North	18	S	21
								41	off	
								46	97	
30	1300-Along Cross Result							17	S	
								56	off	
								59	87	

KEY = All speeds in cm/sec  
N = Northward, Shore parallel  
S = Southward, Shore parallel  
on = onshore off = offshore

Table 4: Current Data (Concluded)  
Mar 1991

Alongshore Cross-shore Resultant Time Day	Pier Measurements						Beach Measurements			Current Meter	
	Dye at (579 m) (surface)		Dye at Mid-Surf Zone (surface)		(500m Updrift)		Dye 12m offshore (surface)		0.9 km Offshore Depth -5.6m (NGVD) ID #519		
	Speed	Dir	Distance from Baseline	(m)	Speed	Dir	Location	Speed	Dir	Speed	Dir
31 0100-Along Cross Result										13	S
										33	off
										35	92
31 0700-Along Cross Result	55	S			61	S				12	S
	8	off	177		6	off	North	53	S	25	off
	56	151			61	154				28	96
31 1300-Along Cross Result										14	S
										31	off
										34	94
31 1900-Along Cross Result										14	S
										25	off
										29	99

KEY = All speeds in cm/sec  
 N = Northward, Shore parallel  
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#### PART V: SUPPLEMENTAL OBSERVATIONS

Visual wave direction measurements (Table 5) of both the primary wave train (i.e. that having the larger wave heights) and the secondary wave train (which must be clearly distinguishable as a wave train separate from the primary waves but not surface chop or capillary waves) are taken daily at the seaward end of the pier. The direction of the primary wave train just north of the seaward end of the pier is also determined using a Raytheon Marine Pathfinder radar and measuring the alignment of the wave crests at approximately the same location as the visual measurements. The pier axis (considered perpendicular to the beach at the FRF) is orientated 70 deg east of true north; consequently, wave angles greater than 70 deg indicate that the waves were coming from the south side of the pier.

The width of the surf zone (seawardmost breaker position to shoreline) is determined from the pier deck.

Measurements of surface water temperature, density, and visibility are also taken daily at the seaward end of the pier. A jar along with a thermometer is lowered about 0.3 m into the water and allowed to remain for at least one minute. The jar is removed, the temperature read, and a hydrometer is used to determine the density. A Secchi disc is used to determine the surface visibility.

Table 5: Supplemental Observations

Mar 1991

Day	Time	Wave Approach		Radar Wave Angle deg from True N	Width of Surf Zone.m	Water Characteristics at Pier End		
		Primary	Secondary			Temp., C	Density g/cc	Secchi Vis., m
1	0810	none visible			64	10.0	1.0241	1.2
2	0810	110			203	10.5	1.0242	2.1
3	0925	115		100	195	11.1	1.0250	0.6
4	0810	125	140	105	191	11.1	1.0250	1.2
5	0810	none visible			160	11.7	1.0248	1.5
6	0810	none visible			126	12.2	1.0248	1.5
7	0818	110		90	169	12.2	1.0250	1.2
8	0811	30		40	177	11.7	1.0252	0.6
9	0734	30		55	191	10.0	1.0207	1.8
10	0920	45		55	160	9.2	1.0192	1.8
11	0810	25		40	199	9.4	1.0207	0.6
12	0815	30	20	50	193	8.9	1.0210	1.5
13	0840	65		60	137	8.9	1.0208	1.5
14	0815	50	20		179	8.8	1.0209	3.0
15	0820	30	5	55	157	8.9	1.0218	0.6
16	0740	20		60	272	7.8	1.0211	0.9
17	0955	70			179	8.9	1.0232	0.6
18	0810	95	5	70	158	8.9	1.0228	1.2
19	0820	100	5	80	154	8.9	1.0242	2.1
20	0807	none visible			154	9.4	1.0232	2.1
21	0810	70	130	70	111	9.4	1.0216	3.4
22	0815	70	130	70	57	10.0	1.0240	0.6
23	0740	40			18	10.3	1.0240	3.4
24	0920	75	120		110	11.7	1.0218	1.8
25	0733	60	30		91	10.5	1.0120	2.4
26	0826	40		55	30	10.5	1.0202	2.7
27	1048	75		70	98	11.7	1.0205	3.0
28	0830	75	120		15	10.0	1.0250	0.9
29	0843	145			11	10.0	1.0246	1.8
30	0819	90	30	100	15	10.0	1.0252	1.5
31	0825	55		55	110	10.5	1.0214	1.5

#### PART VI: WATER LEVELS

Since 1978, the National Oceanic and Atmospheric Administration (NOAA)/National Ocean Service (NOS) has operated a primary tide station (No. 865-1370) at the seaward end of the FRF pier. A Leupold-Stevens digital recording float-type tide gage is used to collect instantaneous water level data every 6 minutes throughout the month.

The variation in water level during the month is shown in Figure 4 along with a list of mean and extreme values. This presentation is useful in identifying effects of both meteorological and astronomical forces on the open coast water level.

Table 6 contains the time at the center of each 12.42-hr tidal cycle and the range, high, low, and mean water levels during each tidal cycle.

## FRF Tide Heights

Mar 1991

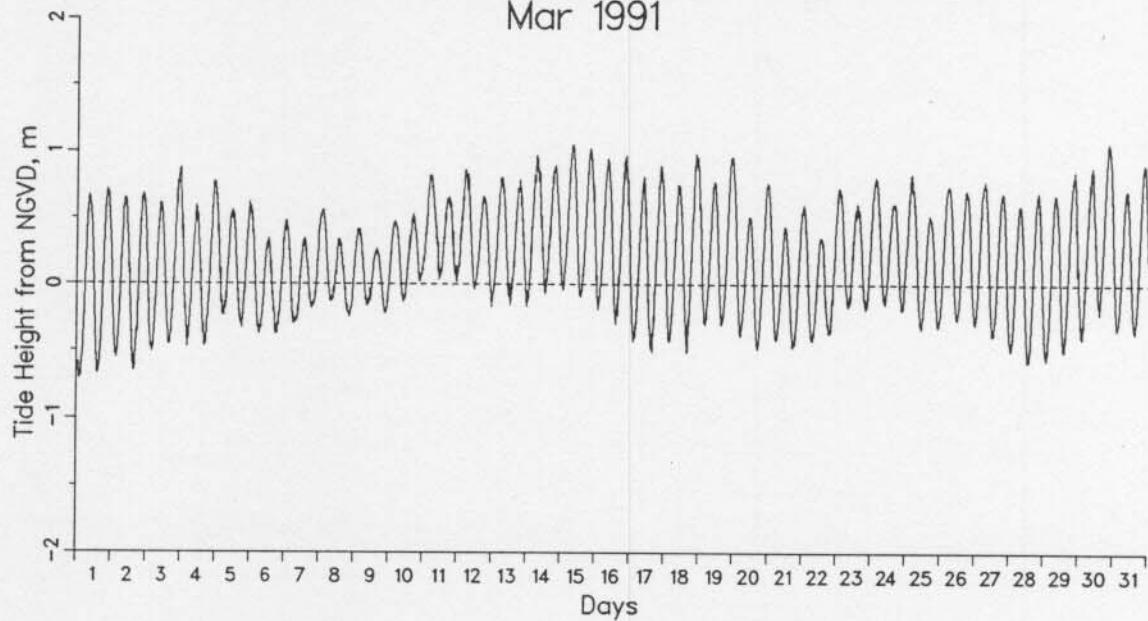


Figure 4. Water level time history

### Monthly Water Levels,m NGVD

Extreme Low = -0.71 on day 1 at 54 EST  
Extreme High = 1.07 on day 30 at 1912 EST  
Monthly Mean = 0.20  
Mean Low = -0.33  
Mean High = 0.70  
Mean Range = 1.03

Table 6: Water Levels.m NGVD

		Mar 1991			
Day	Mid-Cycle Time	Low	High	Mean	Range
1	430	-0.71	0.66	-0.01	1.37
1	1655	-0.67	0.71	0.05	1.38
2	520	-0.55	0.65	0.04	1.20
2	1745	-0.65	0.68	0.06	1.33
3	610	-0.51	0.61	0.04	1.12
3	1836	-0.45	0.87	0.19	1.33
4	701	-0.47	0.59	0.05	1.06
4	1926	-0.46	0.78	0.19	1.24
5	751	-0.26	0.55	0.14	0.80
5	2016	-0.33	0.62	0.13	0.94
6	842	-0.37	0.35	-0.04	0.72
6	2107	-0.37	0.48	0.06	0.85
7	932	-0.30	0.34	0.01	0.64
7	2157	-0.18	0.56	0.20	0.74
8	1022	-0.21	0.34	0.06	0.55
8	2248	-0.24	0.42	0.10	0.66
9	1113	-0.16	0.27	0.05	0.43
9	2338	-0.22	0.47	0.16	0.69
10	1203	-0.14	0.53	0.20	0.67
11	28	0.02	0.82	0.45	0.80
11	1254	0.03	0.66	0.35	0.62
12	119	0.02	0.86	0.44	0.84
12	1344	-0.04	0.66	0.30	0.70
13	209	-0.17	0.80	0.34	0.97
13	1434	-0.16	0.78	0.30	0.94
14	300	-0.17	0.97	0.45	1.14
14	1525	-0.07	0.90	0.43	0.97
15	350	-0.04	1.05	0.49	1.09
15	1615	-0.09	1.02	0.45	1.12
16	440	-0.22	0.94	0.36	1.16
16	1705	-0.36	0.97	0.31	1.33
17	531	-0.46	0.81	0.14	1.28
17	1756	-0.51	0.89	0.23	1.40
18	621	-0.44	0.75	0.15	1.19
18	1846	-0.51	0.98	0.33	1.50
19	711	-0.30	0.77	0.21	1.08
19	1937	-0.38	0.96	0.35	1.34
20	802	-0.48	0.52	0.03	1.00
20	2027	-0.48	0.76	0.18	1.24
21	852	-0.48	0.44	-0.03	0.91
21	2117	-0.46	0.60	0.09	1.05
22	943	-0.42	0.35	-0.04	0.77
22	2208	-0.36	0.73	0.24	1.09
23	1033	-0.17	0.61	0.22	0.77
23	2258	-0.19	0.81	0.35	0.99
24	1123	-0.15	0.61	0.24	0.76
24	2349	-0.20	0.83	0.32	1.03
25	1214	-0.34	0.52	0.10	0.86
26	39	-0.32	0.74	0.25	1.06
26	1304	-0.27	0.71	0.22	0.97
27	129	-0.30	0.77	0.24	1.08
27	1355	-0.39	0.69	0.13	1.08
28	220	-0.50	0.59	0.04	1.09
28	1445	-0.58	0.69	0.05	1.27
29	310	-0.57	0.67	0.07	1.24
29	1535	-0.50	0.85	0.17	1.36
30	401	-0.41	0.89	0.25	1.30
30	1626	-0.22	1.07	0.43	1.29
31	451	-0.34	0.71	0.17	1.05
31	1716	-0.36	0.91	0.30	1.27

## PART VII: NEARSHORE PROFILES

A. Nearshore Profiles. In order to document profile response away from the pier, surveys of four profile lines extending 900 to 1,000 m from shore and located 489 and 581 m north and 517 and 608 m south of the FRF pier are conducted bi-weekly, after storms, and during more complete bathymetric surveys.

These profiles are obtained using the CRAB-Geodimeter surveying system; a Geodimeter 140-T self-tracking, electronic theodolite, distance meter, in combination with the Coastal Research Amphibious Buggy (CRAB), a 10.7 m high, self-powered, mobile tripod on wheels.

Figure 5 shows the last survey in February and the two surveys in March on profile line 188, located 517 m south of the pier. A significant amount of accretion on the foreshore (100 - 200 m) resulted in the creation of a substantial berm (120 m). Further offshore the nearshore bar (200 - 360 m) migrated 15 m shoreward. There were only minor changes to the remainder of the profile.

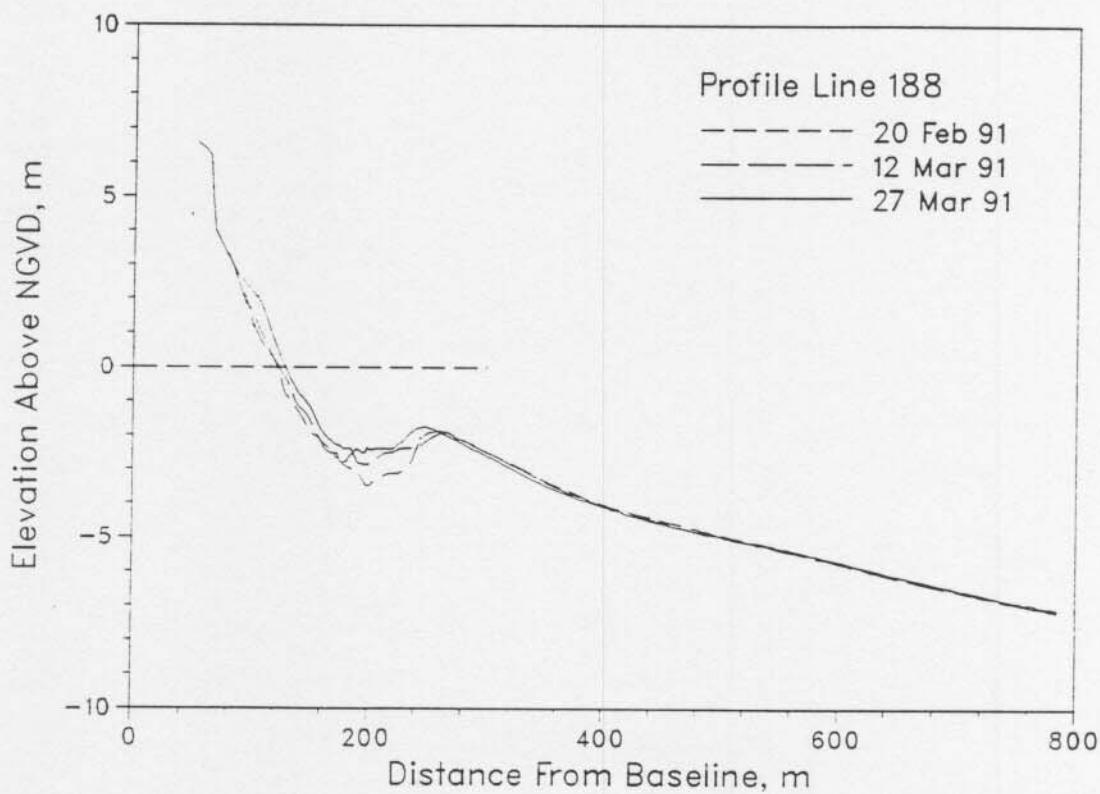


Figure 5. Monthly CRAB profiles on profile 188 - 517 m south of pier.

The profile envelope (Figure 6) reflects the maximum changes that occurred on the profile during 1991. The accretion on the foreshore is responsible for the large change to the envelope.

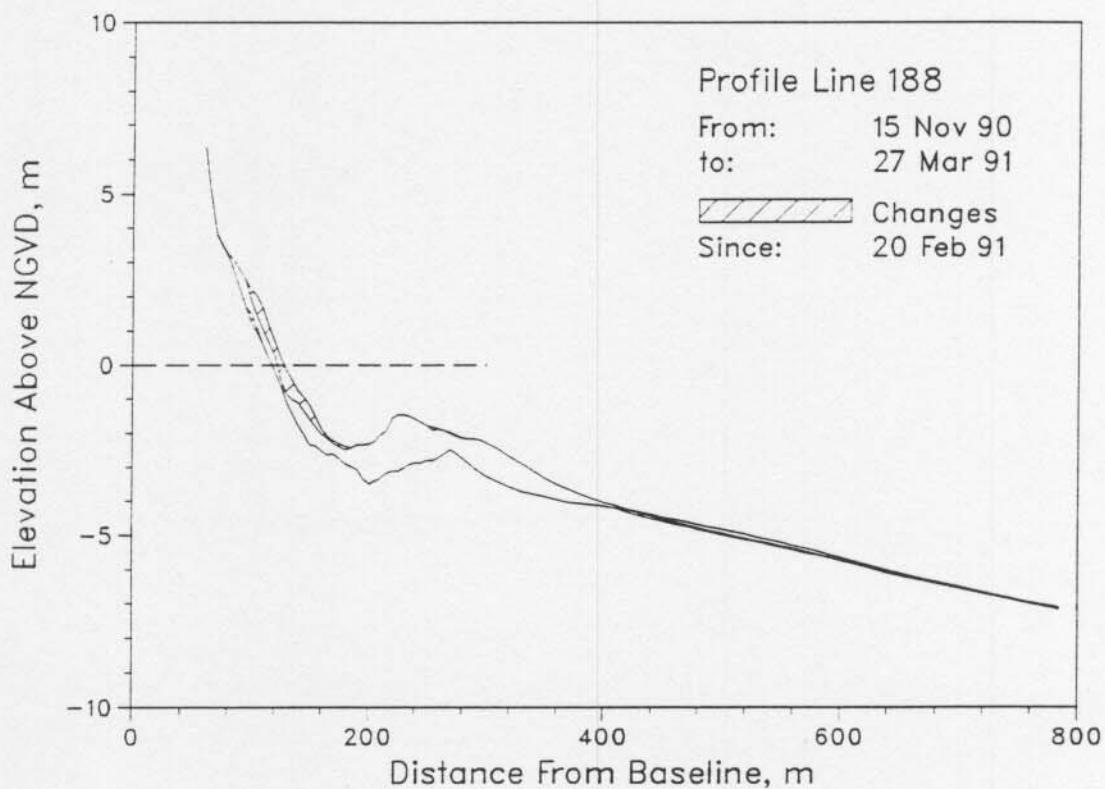


Figure 6. CRAB profile envelope - profile 188.

B. Bathymetry. Figure 7 includes a two- and three-dimensional contour map and a change plot derived from the bathymetric survey on 27 March. Wide contour lines on the change diagram represent eroded areas; thin lines indicate deposition.

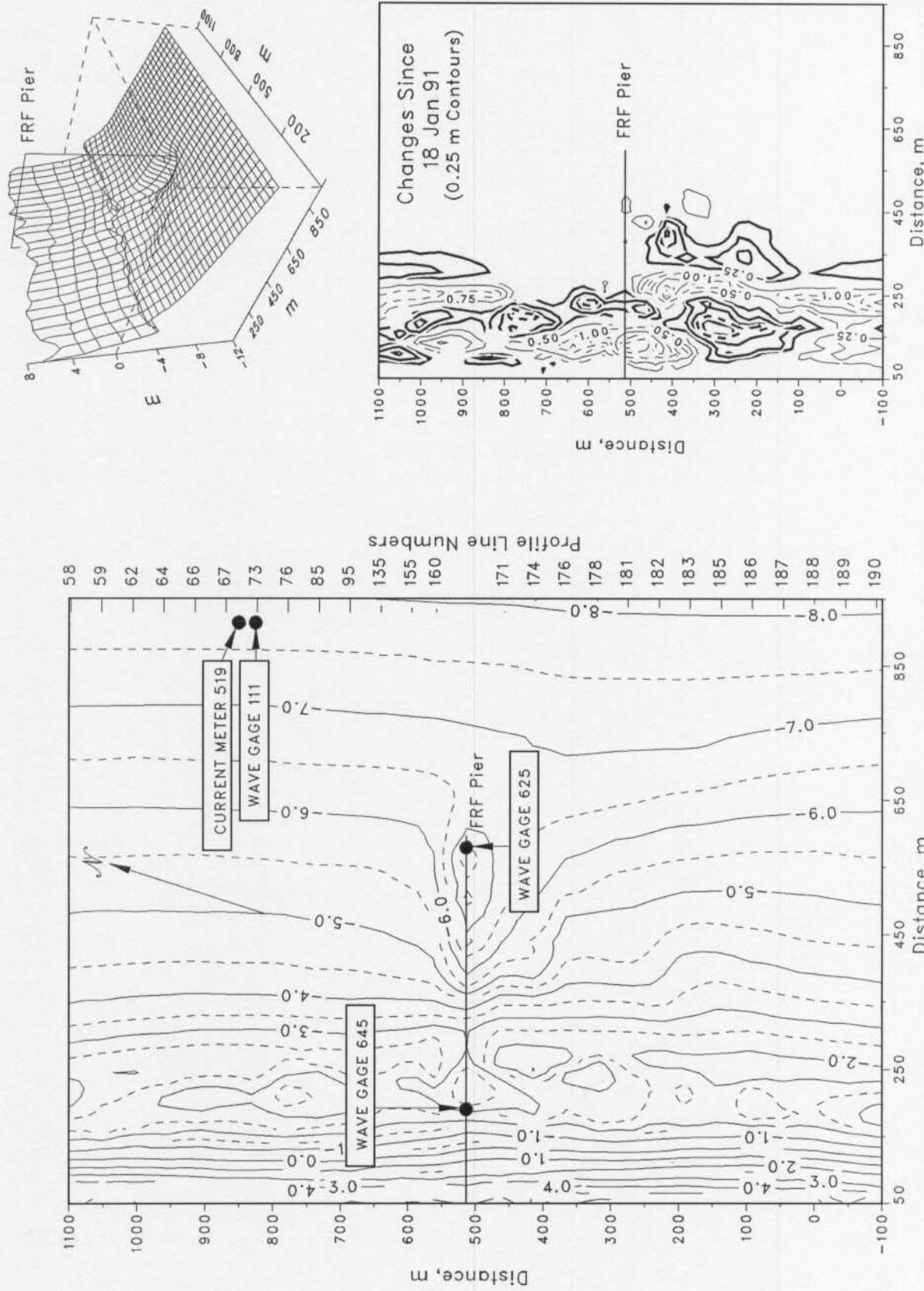


Figure 8. FRF bathymetry 27 Mar 91 depths relative to NGVD

## PART VIII. SPECIAL EVENTS

A. Storm Data Collection. The following list identifies times when the significant wave height at the seaward end of the pier (i.e. as measured near the end of the pier) exceeded 2 m and four contiguous 34 minute wave records were obtained every three hours:

<u>Start</u>	<u>End</u>
6 Mar (2234)	7 Mar (1442)
29 Mar (1708)	29 Mar (2200)

### B. Storm Synopsis.

6-7 March - Winds from a strong Canadian high pressure system began to generate storm waves at the FRF late on 6 March. The maximum  $H_{mo}$  (at gage 625) of 2.50 m ( $T_p = 7.53$  sec) was attained at 0208 EST on 7 March. Maximum winds (from northeast) exceeding 16 m/s occurred at 0542 EST also on 7 March.

29 March - Developing over South Carolina on 29 March this storm rapidly moved to the northeast being located off the Virginia coast by 30 March. Maximum winds approaching 16 m/s peaked at 1634 EST on 29 March with the maximum  $H_{mo}$  (at gage 625) of 2.22 m ( $T_p = 6.92$  sec) occurring later the same day at 1934 EST. The minimum atmospheric pressure of 1014 mb was recorded at 0400 EST on 30 March. Total precipitation was 30 mm.

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